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course, names the trustees; and subsequent vacancies in the board are filled by cooptation. This is a new species of corporation; but the two or three already organized hold large funds, which are likely to be greatly augmented in the future. And there is no limit to the number of such corporations, except the limit to the number of persons who possess wealth and desire to distribute it in this fashion.

I can not but think that these corporations create a new and dangerous situation for the independent and privately endowed universities. Just in proportion as these are supported by those benevolent corporations is their center of gravity thrown outside themselves. It is no longer a case of a rich man giving his money, going his way (eventually dying), and leaving the university free to manage its own affairs. The purse strings are now controlled by an immortal power, which makes it its business to investigate and supervise, and which lays down conditions that the university must accept if it is to receive grants of money. An irresponsible, self-perpetuating board, whose business is to dispense money, necessarily tends to look at every question from the pecuniary point of view; it wants its money's worth; it demands immediate and tangible results. Will not its large powers and enormous influence in relation to the institutions dependent upon it tend to develop in it an attitude of patronage and a habit of meddling? The very ambition of such a corporation to reform educational abuses is itself a source of danger. Men are not constituted educational reformers by having millions to spend. And, indeed, an irresponsible, self-perpetuating board of this sort may become a real menace to the best interests of the higher education. In the fancied interests of capital, or religion, or of education itself, it may galvanize the intellectual life of the institution it undertakes to foster.

A board of this kind should be answerable to the public, like the regents of a state university. Or, better still, let the millionaire trust the boards of trustees of colleges and universities and give them outright the capital he intends to devote to educational purposes.

I believe that in all cases this plan would be best for education and best for the public interest. I make no exception of the Carnegie Foundation for the Advancement of Teaching, to which Mr. Carnegie has given such large endowment for the pensioning of professors in the colleges, technical schools and universities of the United States and Canada. And I certainly speak with no prejudice, as I regard that endowment as the best thing any benefactor has ever done for higher education in America, and I have myself the honor of being one of the trustees. But I look with concern and anxiety on the influence of such corporations on the free and independent life of our institutions of learning and research.—President Jacob G. Schurman, of Cornell University, in an address before the National Association of State Universities.

SCIENTIFIC BOOKS

The Absorption Spectra of Solutions. By HARRY C. JONES and JOHN A. ANDERSON. Publication No. 110, Carnegie Institution, Washington, D. C. 1909.¹

This investigation of absorption spectra represents another chapter in that study of solutions, to which Professor Jones and his coworkers have so indefatigably applied themselves. Here, as before, the guiding idea has been to obtain evidence for or against the existence of *hydrates*, or more generally, of *solvates* in solution.

To investigate a system in this way, that is, by observing the effect produced by the system upon light which has passed through it, has one decided advantage. It does not in any way disturb the state of the system. When we shall understand more thoroughly the mechanism of this absorption, such a method may become not only a very rapid, but also a very accurate and elegant means of analysis. Even in our present deep ignorance in regard to this phenomenon it can often furnish us important information, as the authors of the monograph under discussion have amply demonstrated.

¹ A somewhat abridged account of this investigation has appeared in the March and April numbers of the *American Chemical Journal* of this year (1909).

The principle which underlies the whole research is that the absorption spectrum of a solution consists simply of the superposed absorption spectra of all the molecular species present in the solution. In a solution of even a single solute there may be a large number of these molecular species, namely, ions, undissociated molecules, aggregates of the ions or of the molecules, and compounds of ions and undissociated molecules with the solvent. It is evidently no simple matter to unravel the spectrum of so complicated a system and to determine the origin of the various bands.

The method by which the authors have attempted to do this has been to keep the number of molecules of some one particular species in the path of the beam of light constant, while varying the amounts of the other species, and then observing the effect produced upon the absorption spectrum. Unfortunately, the only molecular species about which we know enough to make it possible to apply this method are the simple ions and undissociated molecules. The authors therefore only carried out experiments, keeping, first, the total amount of salt, second, the number of undissociated molecules and, third, the number of ions in the path of the beam of light constant.

Many solutions were studied under the first-named conditions, that is, keeping the total amount of salt in the path of the light constant. Only a very few of these showed no change in their absorption spectra with changing concentration. This, of course, was to have been expected from our general knowledge of solutions, for the absorption spectra would only remain unchanged when either the relative concentrations of the different absorbers did not change with the concentration, or where the absorption spectra of all the different kinds of absorbers were identical. The first alternative is perhaps never fulfilled, but the second is very probably the explanation of the constant band of nickel sulphate solutions in the ultra-violet and of the whole constant spectra of dilute neodymium and praseodymium solutions.

Nearly as many solutions were studied under the second or third of the above condi-

tions, that is, keeping the number of undissociated molecules or of ions in the path of the light constant. If, when the number of undissociated molecules was kept constant, the absorption *decreased* with the dilution, or if, when keeping the number of ions constant, the absorption *increased* with the dilution, we should be forced to the conclusion that the change in the absorption spectrum with the dilution could not be explained as being due simply to the differing absorption spectra of the ions and the undissociated molecules, as Ostwald at first proposed. Instead, we should be obliged to assume that other absorbers than the ions or undissociated molecules must have been present and that their formation or decomposition with the changing concentration of the solution was responsible for the observed variations. Just such variations were observed in the ultra-violet bands of copper salts and of cobalt chloride, in the red bands of cobalt salts, and in the whole spectrum of ferric chloride. It follows then that in these solutions, at least, other absorbers than simply ions and undissociated molecules must be present.

Two possibilities are suggested as to the nature of these additional absorbers. They may be either *aggregates* of the undissociated solute molecules or of the solute ions, or they may be *compounds* of the solute ions or molecules with the solvent. To decide between these two possibilities the authors cite the observations of Hartley, on the change of the absorption spectrum of salt solutions with the temperature. Hartley found that a rise in temperature in general produces the same effect as an increase in concentration. This, the authors consider, is evidence against the assumption of aggregates, for they reason that a rise in temperature would tend to break up the aggregates, while increase in concentration would have just the opposite effect, and hence produce an opposite, instead of the same effect on the absorption spectrum. It is not easy to see that this argument is conclusive, for whether or not the aggregates will break up with rising temperature will depend upon the heat change incident to their formation. If

heat is absorbed in the process, then a rise in temperature would increase rather than decrease their stability.

On the other hand, the authors reason that the assumption of compounds between solute and solvent, or the assumption of solvates, is in full accord with the observations of Hartley, for not only would rise of temperature tend to dissociate the solvates—but so would increasing concentration of solute. Here again, and for the same reason, it would seem that the argument, though reasonable, is not absolutely convincing, for it is by no means certain that a rise of temperature always accompanies the formation of solvates.

Another method of attack adopted by the authors was to study the absorption spectra of solutions of salts in ether, acetone and alcohol, and in mixtures of these solvents with water. Many salts when dissolved in these non-aqueous solvents gave different absorption spectra for different salts of the same colored ion, but the spectrum of any one salt was different in different solvents. In mixtures of water with non-aqueous solvents, many salts, like neodymium chloride, for instance, showed no marked change in the spectrum when the amount of water was varied from 100 per cent. to 15 per cent. But as the amount of water was still further reduced, the spectrum was found to consist of a superposition of the spectrum of the aqueous upon that of the non-aqueous solution. Similarly, when praseodymium chloride was dissolved in mixtures of water and of ethyl or methyl alcohol the same sort of change was in general observed, except that in the alcoholic solutions there appeared an entirely new and very brilliant band in the ultra-violet, having no analog whatever in the spectrum of the aqueous solution. The conclusion is drawn that these facts and others of a similar nature are inexplicable on any other than the solvate theory of solutions—and further, that solvates of *both* undissociated molecules and of ions are formed. In the case of cobalt and copper salts, the authors conclude that a series of solvates of varying complexity are formed, while in the solutions of the rare earth which were studied there exists but a single solvate.

Finally it was observed that neodymium nitrate and neodymium chloride have very different spectra in concentrated aqueous solutions, and that on dilution, the spectrum of the chloride changes but slightly, while that of the nitrate changes considerably and becomes identical with that of the chloride. The authors explain this phenomenon as follows. The nitrate radical, consisting of twelve atoms, is very much more complicated than the chloride radical, and hence would affect the light vibrations of the neodymium atom to a much greater extent. The effect of increasing solvation would, on the one hand, be of less relative importance to the nitrate than the chloride molecule, and, on the other hand, the effect of dissociation, that is, the separation of the nitrate radical from the neodymium atom, would produce much greater changes in its absorption spectrum than the removal of the chloride or bromide ions.

It can be seen from this cursory review how promising and yet how difficult is this line of attack. With the splendid spectrophotographs furnished by this investigation as a guide, still more valuable results might be anticipated from an accurate spectrophotometric study of the same solutions. The above qualitative tests of the various theories might then be supplemented by strictly quantitative ones.

ARTHUR B. LAMB

The Genera of Fungi. By FREDERIC EDWARD CLEMENTS, Ph.D., Professor of Botany and Head of the Department of Botany in the University of Minnesota. Pp. iv + 227, octavo. Minneapolis, The H. W. Wilson Company. 1909. \$2.00.

This long-expected key to Saccardo's "Sylloge Fungorum" has now appeared from the press, as a thinnish octavo volume, bound in plain green cloth. It is not so large as to be unhandy in the using, and yet it is large enough to secure that respect from librarians and library users that its usefulness demands. In the time that has elapsed since the publication of the mimeographed edition a couple of years ago, the author has enlarged its scope, so that now a number of things are included that were not found in the original work.